· Appendix B·

Vegetation Baseline Study, Mesquite Mine Project Imperial County, California

Prepared by Bamberg Associates & Nighthawk Ecological

VEGETATION BASELINE SURVEY

MESQUITE MINE PROJECT

IMPERIAL COUNTY, CALIFORNIA

Prepared for:

Newmont Gold Company
Mesquite Mine
6502 East Highway 78
Brawley, California 92227-9306

Prepared by:

Samuel A. Bamberg, Ph.D., Bamberg Associates
Ingrid E. Hanne, M.S., Nighthawk Ecological
8344 S. Everett Way, Unit A
Littleton, Colorado 80128

September 1999
Revised March 2000

TABLE OF CONTENTS

1.0 INTRODUCTION 1

2.0 SITE DESCRIPTION 3

2.1 General Site Description 3

2.2 Proposed Expansion Facilities 4

3.0 VEGETATION ANALYSIS AND SALVAGE SOIL MAPPING METHODS 5

3.1 Determination of Vegetative Types and Subtypes Within Four Extension Areas ... 5

3.2 Vegetation Transects Within Vegetative Subtypes 6

3.3 Salvage Soil Determination 7

4.0 RESULTS OF VEGETATION SURVEYS 7

4.1 General Vegetation Description 8

4.2 Vegetation Types and Subtypes 10

4.2.1 Shrub/Scrub Vegetation Type 15

4.2.2 Tree/Shrub Vegetation Type 16

4.3 Results of Quantitative Vegetation Surveys 17

4.3.1 Perennial Plant Density 17

4.3.2 Perennial Plant Cover and Diversity 18

4.4 Salvage Soils 23

5.0 SUMMARY AND DISCUSSION 27

LIST OF FIGURES

Figure 2-1 Site Location Map – Mesquite Mine
Figure 2-2 Illustration Map - Previously Permitted Footprint vs. 11/99 Proposed Footprint
Figure 4-1 Vegetation Types on the Big Chief Open Pit North Extension Area
Figure 4-2 Vegetation Types on the Big Chief OISA Expansion Area
Figure 4-3 Vegetation Types on the East Rainbow South OISA Expansion Area
Figure 4-4 Vegetation Types on the East Rainbow North OISA Expansion Area
Figure 4-5 Soil Salvage Potential for the North Pit Extension Area. Mesquite Mine, October 1999
Figure 4-6 Soil Salvage Potential for the East Rainbow North OISA. Mesquite Mine, October 1999
Figure 4-7 Soil Salvage Potential for the East Rainbow South OISA. Mesquite Mine, October 1999

LIST OF TABLES

Table 2-1 Acreage of Extension Areas
Table 4-1 Identification and Locations for Baseline Vegetation Surveys for Mesquite Mine, 1999
Table 4-2 Perennial Plant Density by Vegetative Subtype, Mesquite Mine 1999
Table 4-3 Plant cover and diversity by vegetation subtype, Mesquite Mine 1999.
Table 4-4 Density for each area by vegetation subtype with percent of each vegetation subtype, Mesquite Mine 1999.
Table 4-5 Plant cover and diversity for each area by vegetation subtype, Mesquite Mine 1999.
Table 4-6 Soil Salvage for Extension Areas, Mesquite Mine, 1999

APPENDICES

Appendix A List of Common Plant Species at Mesquite Mine

Appendix B - Photographs
Photograph P-1 View south across the north extension of the Big Chief Pit.
Photograph P-2 View north across upland slopes of the Big Chief OISA.
Photograph P-3 View to the north of shallow washes in the East Rainbow South OISA.
Photograph P-4 View to the west of the East Rainbow North OISA.

1.0 INTRODUCTION

In this report we present the baseline vegetation analysis and potential soil salvage for the proposed Mesquite Mine expansion project for Newmont Gold Company into four areas of the mine, one previously permitted. The Mesquite Mine is an operating gold mine located in the Colorado Desert region of southern California in eastern Imperial County. The facility currently encompasses approximately 5,200 acres, and has a present disturbance of 3,700 acres under existing permits. The mine is approximately 35 miles east of Brawley in a virtually unpopulated portion of the Mesquite Mining District. The site is located adjacent to the foothills of the Chocolate Mountains. Please refer the Plan of Operations (Newmont Gold, Revision November 1999) for more discussion on operating history and project background. This report was originally prepared in Fall 1999 for four extension areas delineated in a POO, November 1998. The text and some tables have been revised (March 2000) to reflect recent proposed changes in the planned operations.

Our study involved field trips to the site to coordinate, design the program, and to conduct the vegetation and soil surveys. This baseline report presents information on the vegetation resources with emphasis on present vegetative conditions. This study provides information in sufficient detail to support state and federal environmental review and permitting requirements, and to determine impacts of proposed actions. Our quantitative descriptions include perennial plant density as required by SMARA and the California Office of Mining and Reclamation (OMR). In addition, we provide plant cover and diversity measurements and topographical information to provide a more complete description of the four expansion areas.

Soil appropriate for future reclamation activities was mapped within each of the four areas surveyed. Although no topsoil develops in this desert climate, surface soils can be used as a source of seed and limited organic residue to promote reclamation efforts. Areas with potential salvage soil were mapped and acreages calculated for this resource.

The vegetation and soil data we collected provides information for the following activities or requirements:

- support reclamation planning including revegetation success criteria
- support and supply information for an EIS

- provide species identification and estimated densities for permitting, clearing, and salvage of protected native plants

2.0 SITE DESCRIPTION

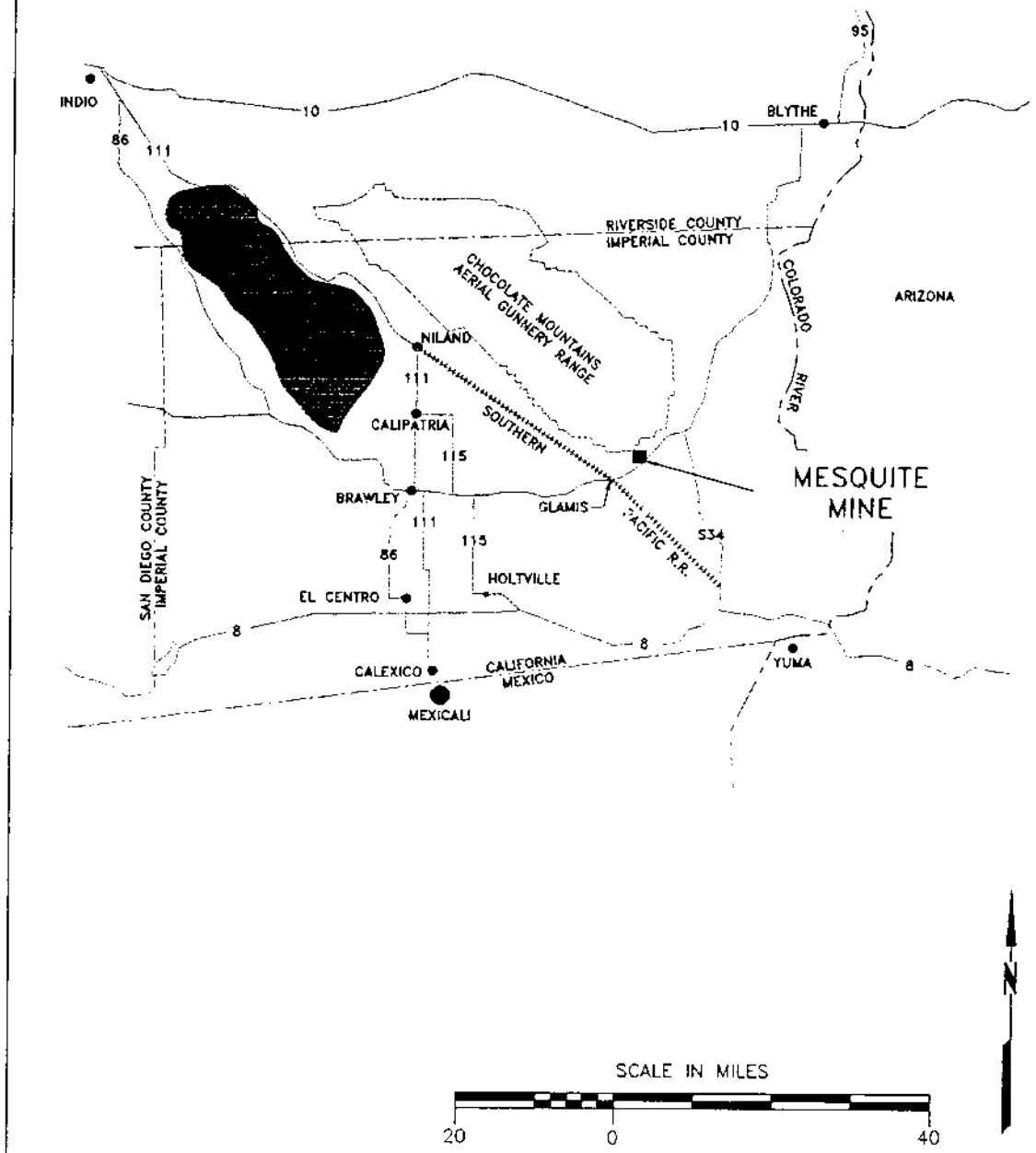
The following description presents those features of the project site that are important for the types and amounts of vegetation present. We also discuss topographic, soils, and other land features related to vegetation.

2.1 General Site Description

The present project site is approximately 5,200 acres of area controlled by the Mesquite Mine. The project site is at an elevation of 600 to 760 feet, and is south of the Chocolate Mountains in Imperial County, California (see map in Figure 2.1). The landform consists of a sloping alluvial fan and some rock outcrop that has formed upland flats and gentle slopes interspersed with incised washes in narrow to broader drainages. The area is characterized topographically by low upland hills and flat surfaces with desert pavement surfaces interspersed with dry washes that flow to the southwest.

The soil substrates over most of the site are alluvial deposits and small rock outcrop partially covered with a broken discontinuous layer of basaltic cobbles and boulders from an eroded igneous outflow. The flats and uplands have lag gravel surfaces with a thin to non-existent residual soil layer overlying the loose alluvium. These old erosional surfaces are covered with gravel and boulders that have turned black due to oxidation of the rock minerals by the intense sunlight and heat. These surfaces on the rocks are referred to as desert varnish. The light and heat also bakes the soil surface around the rocks and forms a water impenetrable surface. The dark, water impenetrable surface, together with the varnished rocks, is referred to as desert pavement. These surfaces support very little vegetation except where the surface is disturbed by previous activity or recent erosion.

Narrow bands of sand and silt material accumulate in shallow washes and underneath shrubs on the slopes and fans. Shallow wash bottoms accumulate soil material up to a foot and a half deep. The larger, more active washes have a thin to deep veneer of recently deposited gravel and rock in the wash bottoms and fine sand along the channel sides. Channels can be deeply incised in the washes, and the gravelly bottom channels support no vegetation. Sand and gravel move through the site by the flushing action of water flow following infrequent storm events. Vegetation is absent in the active channels, but is abundant on the stable banks and shallow side washes.



NO.	DESCRIPTION	BY	CHKD.	APPROVED	DATE
REVISIONS					

NEWMONT MINING CORPORATION

Mesquite Mine

FIGURE 2-1
SITE LOCATION MAP

BY:	DATE:	DWG NO.	REV
GL	11/98	FIG-001.DWG	

File: E:\100232\P00-1199\FIG-001.dwg

The washes are dry except for flows that occur only after storms as rainfall. No springs, seeps, or permanently wet areas or wetlands were observed during surveys on the proposed expansion sites. Water pools for a short time after rains in depressions in the sandy, gravelly washes. No wetland plants or wet soil exist in the area.

2.2 Proposed Expansion Facilities

To continue operation of the mine, Newmont Gold Company is proposing extension of two of the three existing open pit mines with associated heap leach facilities, overburden/interburden storage areas, and ancillary facilities (see map in Figure 2-2). Four proposed extension area activities are addressed in this report. These four areas are:

- North Extension of the Big Chief Open Pit
- Big Chief OISA
- East Rainbow North Overburden/Interburden Storage Area
- East Rainbow South Overburden/Interburden Storage Area

These areas are a mix of previously permitted and not permitted land by the Mesquite Mine for disturbance. Two other proposed areas not surveyed for baseline vegetation were the Big Chief pit diversion structure, and the eastern extension of the Rainbow pit with associated diversion structure. Vegetation is similar in these areas to the four surveyed. Table 2-1 lists present total acreage and a breakdown of permitted and unpermitted acreage. This table and subsequent text represent areas originally proposed in November 1998. The POO has been revised (November 1999), and the revised acreage can be found in the November 12, 1999, revision. The baseline surveys conducted in April 1999 are included since similar vegetation types cover the newly revised areas.

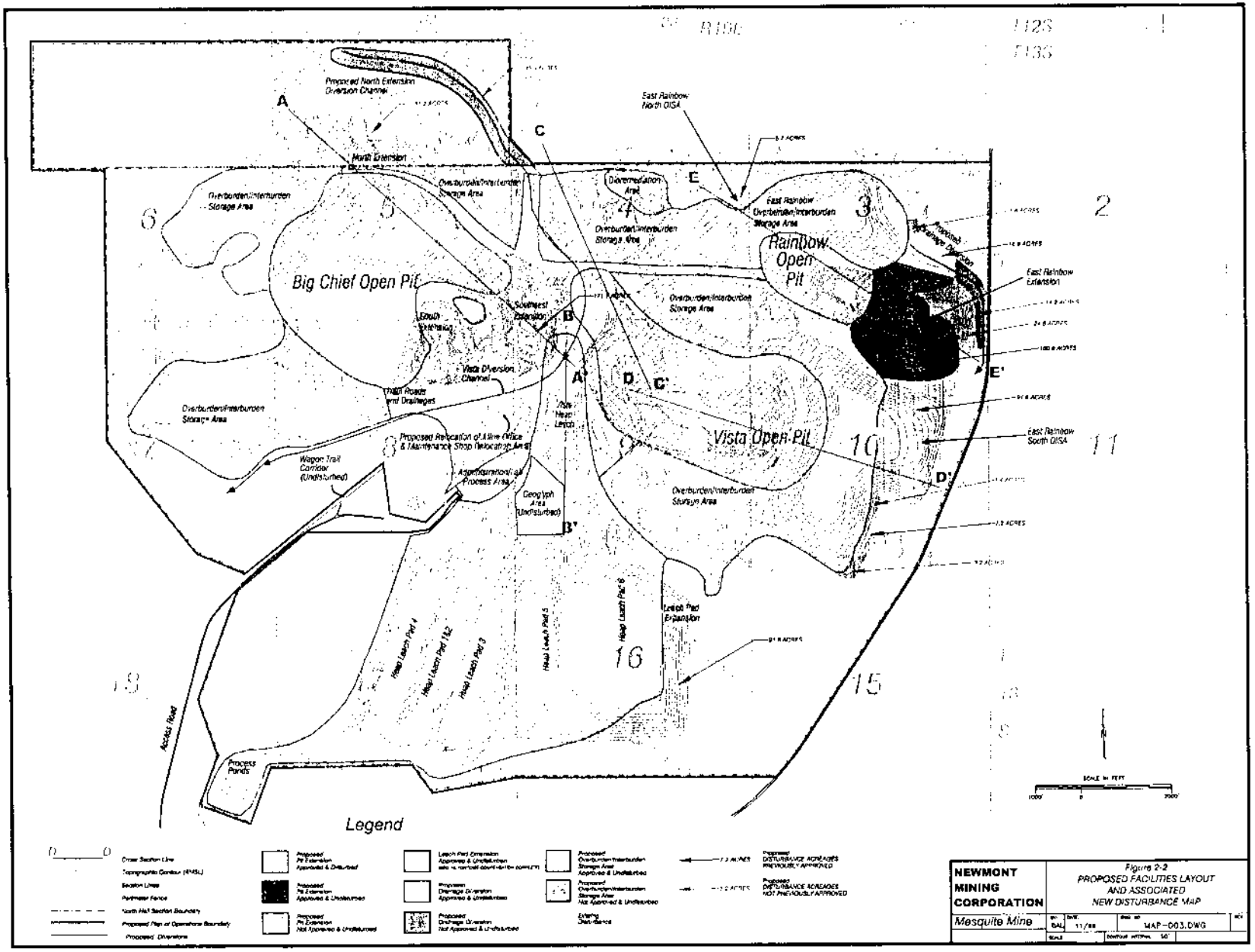

Proposed North Extension Diversion Channel
East Rainbow North OSA
North Extension
Overburden/Interburden Storage Area
Overburden/Interburden Storage Area
Overburden/Interburden Storage Area
Overburden/Interburden Storage Area
Overburden/Interburden Storage Area
Big Chief Open Pit
Rainbow Open Pit
East Rainbow Extension
Southwest Extension
South Extension
Vista Diversion Channel
Haul Roads and Drainages
Overburden/Interburden Storage Area
Proposed Relocation of Mine Office & Maintenance Shop Relocation Area
Agglomeration/Leaching Process Area
Waipon Trail Corridor (Undisturbed)
Geoglyph Area (Undisturbed)
Vista Open Pit
East Rainbow South OSA
Overburden/Interburden Storage Area
Heap Leach Pad 4
Heap Leach Pad 1&2
Heap Leach Pad 3
Heap Leach Pad 5
Heap Leach Pad 6
Leach Pad Expansion
Access Road
Process Ponds
Legend
Cross Section Line
Topographic Contour (MSL)
Section Lines
Perimeter Fence
North Half Section Boundary
Proposed Plan of Operations Boundary
Proposed Diversions
Proposed Pit Extension Approved & Disturbed
Proposed Pit Extension Approved & Undisturbed
Proposed Pit Extension Not Approved & Undisturbed
Leach Pad Extension Approved & Undisturbed
Proposed Drainage Diversion Approved & Undisturbed
Proposed Drainage Diversion Not Approved & Undisturbed
Proposed Overburden/Interburden Storage Area Approved & Undisturbed
Proposed Overburden/Interburden Storage Area Not Approved & Undisturbed
Existing Disturbance
Proposed DISTURBANCE ACREAGES PREVIOUSLY APPROVED
Proposed DISTURBANCE ACREAGES NOT PREVIOUSLY APPROVED
NEWMONT MINING CORPORATION
Mesquite Mine
Figure 2-2
PROPOSED FACILITIES LAYOUT AND ASSOCIATED NEW DISTURBANCE MAP
MAP-003.DWG

Table 2-1. Acreage of Extension Areas (revised to be consistent with November 1999 POO)

Extension Area	Total Acreage	Permitted (acres)	Unpermitted (acres)
North Extension of the Big Chief Open Pit	51	0	45
Big Chief OISA	0	N/A	N/A
East Rainbow North OISA	6	6	0
East Rainbow South OISA	103	99	4

Each of these extension areas is discussed for vegetation types in relation to topography and soils and potential salvage soil in Section 4.0. We didn't monitor the Big Chief Diversion Structure site, but have enough wash vegetation data to determine plant species and densities, and how to grade and form the topography. We also didn't monitor the exact locations of the Rainbow Pit Extension or Diversion Structure areas. We did monitor similar vegetation for the nearby proposed East Rainbow South OISA, and will use this area as baseline information. The Big Chief OISA will not be used or disturbed.

3.0 VEGETATION ANALYSIS AND SALVAGE SOIL MAPPING METHODS

We conducted an initial reconnaissance in April 1999 to determined qualitative characteristics of the four extension areas. This information was applied to determining vegetation types and subtypes and how to best sample this type of vegetation. We decided to first characterize these vegetation subtypes by running belt transects within representative areas. Then we mapped these subtypes within each extension area and determined how extensive each subtype was within each given area. Finally, we determined salvageable soils by a similar method: first determining what characteristics defined a salvage area, then mapping these areas within each extension site, and finally determining how much salvage soil could actually be extracted from these potential salvage areas.

3.1 Determination of Vegetative Types and Subtypes Within Four Extension Areas

We traversed each of the four extension areas to determine the general characteristics of each site. Topography, numbers and sizes of washes, vegetation community changes, and soil types were all noted. This qualitative, baseline information was recorded. We

obtained a mine site aerial photograph for an aerial view and to help with mapping. Each area was mapped to identify vegetation types, size and location of washes, and areas of potentially salvageable soil.

3.2 Vegetation Transects Within Vegetative Subtypes

We adapted field survey methods to sample the type of desert vegetation present in the study area and to increase the data's usefulness in determining shrub density, estimating cover and calculating diversity. The quantitative vegetation survey technique we used was belt transects of linear plots laid end to end along straight compass lines and oriented parallel to the slopes and gradients. The vegetation type and patterns were qualitatively related to the abiotic factors of topographic position, washes and erosion features, and soil types. Each transect was made up of 10 or 12 plots of variable size. Washes were sampled by paired plots aligned perpendicular to both sides of the channel at regular intervals of 50 or 100 feet. In each plot, vegetative variables were recorded on standardized field data forms.

We conducted the quantitative field surveys in April and August 1999. Since the sample plots were primarily for perennial plant density, the time of year for sampling was not critical. The locations, number of samples, variables recorded, and data analysis methods were determined as described below.

Sampling Locations

Belt transects were located to sample the major vegetation types in topographic locations typical for each expansion area. Washes were sampled along relatively stable or undisturbed sections.

Number of Samples

Generally ten plots per linear transect were sampled in each of the vegetation types. The numbers of transects were adjusted for sample adequacy.

Variables

The variables were chosen to determine vegetation characteristics. The variables in the transects measured for vegetation were:

- total number of shrubs (for density)
- percent cover by each plant species (visual estimate)
- vegetative diversity (number of species present)

Individual shrubs by species were counted in each plot. The percent cover of each plant species within each linear plot was determined by a visual estimation technique. We grouped all the plants of one species as a unit and visually assigned a cover.

We analyzed transects for the vegetation parameters of density, ground cover, and diversity. Total vegetative ground cover was determined by averaging the estimated cover for all plots in each transect. Perennial shrub and tree densities were calculated by adding up the shrub/tree counts in each plot, averaging this number for all plots in a transect, and then adjusting this average per transect to an acre basis. Diversity was the total number of perennial plant species (shrubs, cactus, trees, and perennial herbs) recorded in all transects in a given vegetative type.

3.3 Salvage Soil Determination

Topographic and vegetative characteristics that promote the formation of salvage soil were recorded during our site visit. Characteristics we used were absence of desert pavement, a layer of soil with a sandy or loamy texture, and accessibility to equipment. We noted the locations that had these characteristics within the four proposed expansion areas and determined what percent of these locations would have soil that would meet the criteria for being salvageable. We then mapped these salvage areas using ground surveys and aerial photographs of the four expansion areas. Total acreage of the salvage areas was reduced by the percent of potential salvage soil within these salvage areas.

4.0 RESULTS OF VEGETATION SURVEYS

Vegetation on the project study area is typical for this hot, dry desert region of southern California. The vegetation consists of drought resistant perennial species, and annual species that germinate after sufficient rains. In this section, we present the results of the

qualitative and quantitative field surveys conducted. Vegetation types and characteristics are discussed in relationship to topography, soils, and other abiotic factors. The plant community analysis and vegetation parameter of concern, density, for determining reclamation success are calculated and presented.

4.1 General Vegetation Description

The vegetation on the project site is low desert scrub typical of the severe temperate desert areas. The low rainfall (annual average of about 4 inches measured during the past 10 years) and the high daytime temperature (up to 115 degrees Fahrenheit in the summer) of the project area impose special requirements on the plant life. Vegetative cover is extremely low and species diversity is minimal. The existing vegetation is highly adapted to the desert heat and droughts. The vegetation community on the entire study area outside the washes is a mixed desert scrub characterized by *Larrea tridentata* (creosote bush) and *Ambrosia dumosa* (burrobush). The perennial shrubs are the dominant vegetation, with a few herbaceous perennials present. Cover and productivity by annual species is dependent on seasonal moisture. In particular, the seasonal timing and amounts of rain are important. Autumn rains generally germinate the annuals, and late winter and spring rains promote growth. Precipitation was low this year during the growing season from September 1998 through August 1999, so tree/shrub growth was low and annual germination non-existent.

Previous human use impacting vegetation in the project site included roads, access trails and some previous trenching for exploration in the proposed north extension of the Big Chief Pit. Plants have been periodically collected or cut. Many of the older ironwood trees had been cut and were left as old stumps or resprouted bases on sides of washes in portions of the project site. The US Army conducted maneuvers in this area during WWII, and their tracks are still evident.

A list of the plant species found on the Mesquite Mine site is given in Table A-1, Appendix A (nomenclature according to The Jepson Manual: Higher Plants of California, 1993, James C. Hickman, editor, University of California Press, Berkeley and Los Angles, California). The floristics of this area is typical for the southern hot (subtropical) California desert region. This is a low desert region with few frosts. There was a total of 105 plant

species listed as observed on or near the project site, but this is not a complete list for all species present. There were no unusual plant assemblages or sensitive plant species present, except for *Calliandra eriophyllum* (fairy duster). There were several cactus species observed, and some species were fairly abundant such as *Opuntia bigelovii* (teddy-bear cactus). There are a few introduced species of plants, mainly grasses and mustards, such as *Bromus tectorum* (downy chess) and *Brassica tournefortii* (mustard), which have become naturalized in the flora of the deserts.

North Extension of the Big Chief Open Pit

An extension of the existing Big Chief Open Pit Mine toward the north would extend into the northern half of Section 5 of T13S, R19E. The proposed extension would occupy 51 acres. Part of this area is the site of previous mining activity and is disturbed by roads. A large, braided wash flows from the north and is channeled into the existing drainage diversion that flows to the east and then south of the mine site. Some low hills with upland vegetation transect this area from the northwest tapering down to the south central portion. The remaining sections of this area are a relatively flat desert pavement interspersed with a few shallow washes.

Big Chief Overburden/Interburden Storage Area

This area is located immediately to the east of the existing Big Chief Open Pit intersecting the corners of Sections 5, 6, 7, and 8 of T13S, R19E. It is composed entirely of upland vegetation within low hills on a deep alluvium. The hillside soils are stable and water penetration is minimal. This results in low vegetation density and no washes with associated plant communities. This area was eliminated for overburden/interburden storage in the November 1999 revision.

East Rainbow North Overburden/Interburden Storage Area

Overburden/interburden from extension of the Rainbow Open Pit would be stored in two possible areas. One area is to the north of the existing East Rainbow Overburden/Interburden Storage Area located in Sections 3 and 4 of T13S, R19E. It would occupy 6 already permitted acres. The majority of this site is desert pavement interspersed with several shallow to medium washes. Several roads traverse the area as well as a few of General Patton's tank tracks.

East Rainbow South Overburden/Interburden Storage Area and East Rainbow Pit Extension

The area for the East Rainbow South overburden/interburden would be an extension of an existing storage area to the east of the Vista Open Pit Mine. Portions of this area have been previously permitted. This area is located in Section 10 of T13S, R19E and would occupy 103 acres, only 4 acres of which are unpermitted. Drainage across this area on an alluvial bajada has been interrupted due to the realignment of Highway 78 and a large berm around portion of the area. This road and a large berm has disrupted seasonal flow of the complex of washes across this site, and is slowly changing the composition of the vegetation to a drier upland type. The East Rainbow Pit Extension is upslope on the same drainage alluvial bajada as the East Rainbow South OISA. The vegetation is similar in species composition and density.

4.2 Vegetation Types and Subtypes

The vegetation in this portion of the Colorado Desert is generally typed into one category, the creosote shrub type. For this report and reclamation purposes, we have divided the vegetation types in all locations of natural or semi-natural state into two main types. These are:

- shrub/scrub vegetation type on the open, drier alluvial flats and slopes
- tree/shrub vegetation type (microphyll woodland) in drainages and on sides of washes

Refer to maps in Figure 4-1 to 4-4 for a delineation of these types in each expansion area surveyed in mid-1999. The shape and size of these areas were changed in November 1999. The shrub/scrub vegetation type is typical of the creosote type with shrubs being dominant and widely spaced. The tree/shrub vegetation type reflects the higher moisture availability in washes and drainages that results from rain run-off events. The vegetation in shallow washes and on sides of larger washes has greater diversity, variability, and ground cover.

The vegetation within each type differs in species distribution and abundance by location within the site, partly due to segregation of species into topographic features. There are broad patterns of vegetation related to topographic controls of soils and moisture. We have further divided the two vegetation types into subtypes based on species abundance due to their topographic positions.

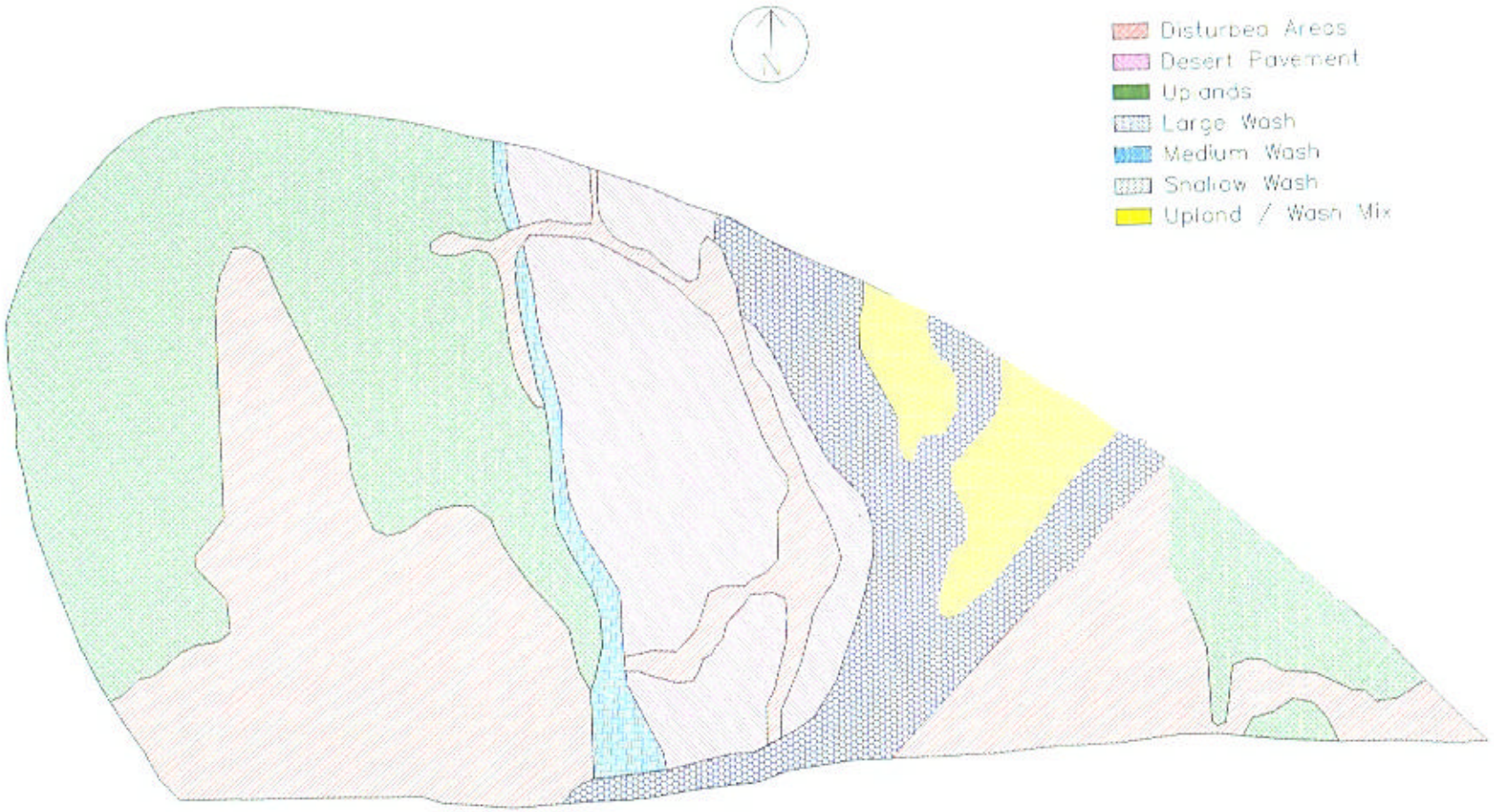


Figure 4-1
Vegetation Types on the Big Chief Open Pit North Extension Area

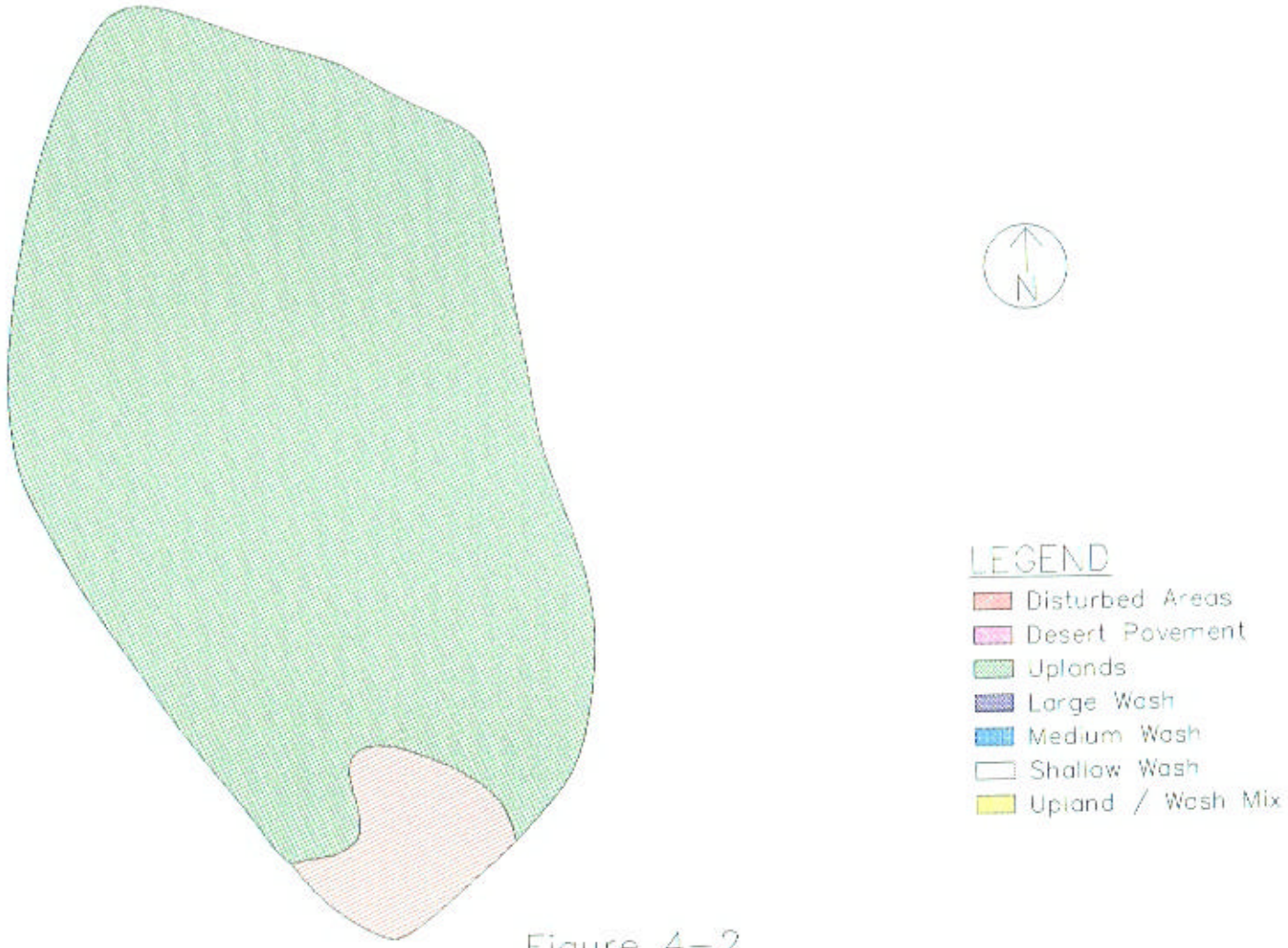
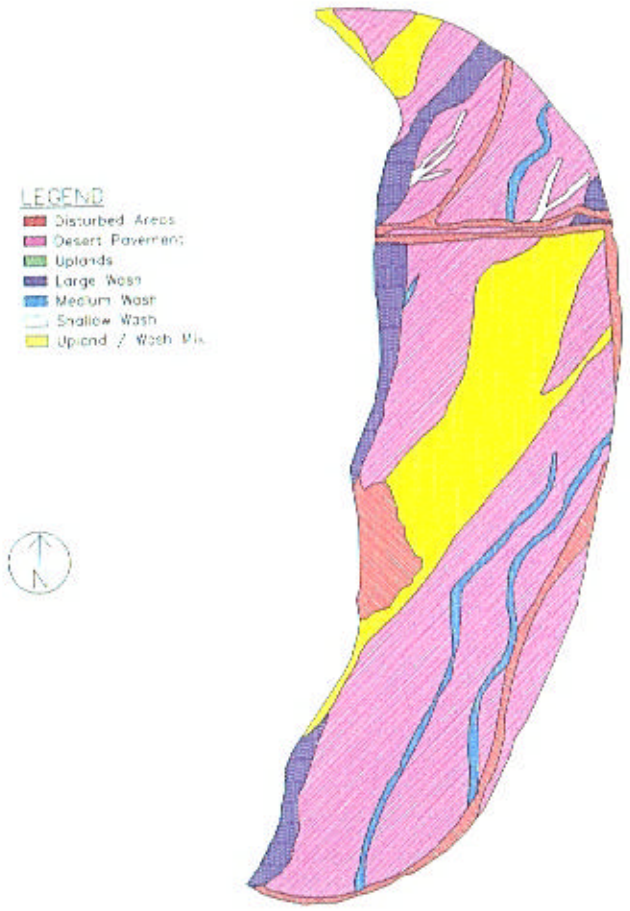


Figure 4-2
Vegetation Types on the Big Chief OISA Expansion Area


LEGEND
Disturbed Areas
Desert Pavement
Uplands
Large Wash
Medium Wash
Shallow Wash
Upland / Wash Mix
N

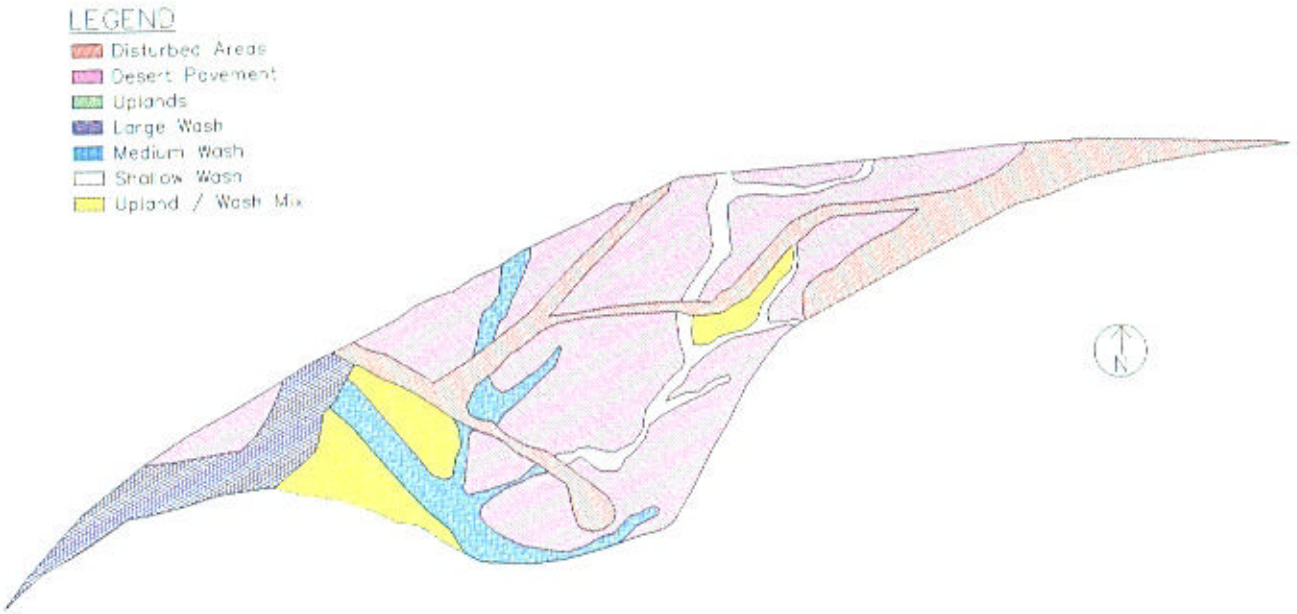


Figure 4–4
Vegetation Types on the East Rainbow North CISA Expansion Area

4.2.1 Shrub/Scrub Vegetation Type

The open, dry alluvial flats and gentle slopes have a shrub/scrub vegetation type, which consists of widely spaced low shrubs and cactus. The major species of shrubs measured in transects were in order of abundance: *Ambrosia dumosa* (burrobush), *Larrea tridentata* (creosote bush), *Encelia farinosa* (inciensio), and *Opuntia bigelovii* (teddy-bear cholla). This type occupies most of the area on the expansion sites, and includes all of the desert pavement areas. On portions of the alluvial flat and slope areas, desert pavement has developed. On this desert pavement, perennial plants do not grow and total vegetative ground cover is almost non-existent (less than 0.1%). The shrub/scrub vegetation is spotty and variable in distribution and species dominance.

As a basis for vegetation typing in the reclamation planning, we identified four topographic subtypes of shrub/scrub vegetation type, these are:

- desert pavement
- upland slopes
- upland slopes and desert pavement complex
- alluvial flats and shallow wash complex

The expansion areas, being in close proximity to the mine and the former highway location, are complicated by disturbance from roads, historical mining, and recent exploration.

Desert pavement occurs on alluvial flats on old undisturbed surfaces and covers much of the sites except the Big Chief OISA. These flat to shallow sloping sand and rock surfaces weather in-place by the sun and arid climate and form an impenetrable surface with high salt content. We estimate these surfaces to be between 1,000 and 10,000 years old, and cover an estimated 45% of the uplands. Vegetation is extremely sparse, and water and seeds generally cannot penetrate the surface. This subtype will not serve as a basis for reclamation planning since the soil and surface conditions cannot be restored during mine reclamation.

Upland slopes have some rock outcrop and thin or no soil. This type occurs on two of the extension areas on the north and west portions of the mine. Density of the vegetation is

very low and is clumped along valley bottoms. The rocks have been highly baked by the sun and arid climate.

Desert pavement and upland slopes complex occurs in most upland areas and covers approximately 15% of the uplands and flatter slopes. These are areas within the desert pavement topography that have had their alluvial surfaces disturbed by erosion or deposition within the last 1,000 years. They are interspersed with desert pavement surfaces. Spacing of the plants is clumped and clumping is dependant on soil type, topographic position, and water availability.

Alluvial flats and shallow wash complex occurs on the eastern portion of the mine site on the gently sloping bajada. This subtype covers fairly extensive areas within this region of the desert. This subtype covers about 10% of the eastern sections of the mine. Roads and fences cross this locale and portions of OISA are on and around the area.

4.2.2 Tree/Shrub Vegetation Type

The tree/shrub vegetation type commonly occurs in the smaller drainages and tributaries and in the major and braided washes. In the major and braided washes, this vegetation type occurs on the sides and banks created by the major water runoff from the upslope large drainage basins during significant precipitation events. Flooding and washing of the old alluvial material creates channels and disturbs the old, weathered surfaces. This allows better penetration of water and seed, and permits a higher cover than on the shrub/scrub vegetation type. A greater variety of plant species and a higher abundance of plants are the results. The major species include those found in the shrub/scrub vegetation type plus other species of trees and shrubs that occur principally in the washes. This type covers a small percentage of the four expansion sites at about 7%. We identified three topographic subtypes of shrub/scrub vegetation type based on the width and depth of the washes:

- broad major washes
- medium subsidiary washes
- shallow subsidiary washes

Broad major washes form in the drainages that cross the study area and continue out onto the broad alluvial flats southwest toward the Algodones Dunes. These washes vary from

almost flat to 15 feet deep and 8 to 60 feet (average 40 feet) wide. The sides of the washes are sandy and support trees and plants (normally above the high water mark), and occasional islands of thick vegetation form on raised islands of the wider sandy bottoms. Trees associated with the major washes include *Olynea tesota* (ironwood) and *Cercidium floridum* (palo verde), and several species of shrubs that occur mainly in washes such as *Bebbia juncea* (sweetbush) and *Hyptis emoryi* (desert lavender).

Medium subsidiary wash vegetation is similar to that in the major washes, and is equally as diverse and abundant including most of the upland species on the edges. The washes are narrower (average 30 feet) and not as deep or broad, and have some finer soils washed or deposited in them. There are fewer and smaller trees. *Pleuraphis rigida* (big galleta), *Asclepias subulata* (ajameta-milkweed), *Calliandra eriophylla* (fairy duster), and *Hibiscus denudatus* (rose mallow) are additional species present. Vegetative cover is irregular on the bottoms and sides.

Shallow subsidiary wash vegetation is similar to uplands in species diversity, but also include a few additional species such as *Krameria* spp (desert ratany) and *Ditaxis* spp (ditaxis).

4.3 Results of Quantitative Vegetation Surveys

The results of the vegetative transect survey are presented in the following sections. The identification and location of the transects are given in Table 4-1.

4.3.1 Perennial Plant Density

Perennial plant densities by species for each vegetative subtype are presented in Table 4-2. The density of shrubs and trees was widely variable depending on the vegetative subtype. The lowest density of perennial plants was on the desert pavement where typically only annual herbaceous plants grow in the wetter years. The next lowest density was in the desert pavement and upland shrub/scrub complex at 85 plants per acre. The highest was in the shallow washes at 1,655 plants per acre.

The most common shrubs as indicated by the densities (Table 4-2) are in order of abundance *Encelia farinosa* (incienso), *Ambrosia dumosa* (burrobush), *Larrea tridentata*

(creosote bush), and the cactus *Opuntia bigelovii* (teddy-bear cholla). The two common tree species, *Olneya tesota* (desert ironwood) and *Cercidium floridum* (palo verde), are mostly confined to washes at relatively low densities. Palo verde was not rooted in any of our transects although it is present within the washes.

4.3.2 Perennial Plant Cover and Diversity

Perennial plant diversity and cover by vegetative subtype is presented in Table 4-3. The average cover for all vegetation measured in the vegetative subtypes varied from to 0 to 0.1% in desert pavement to 25% in medium washes (see Table 4-3). The majority of perennial cover is by shrubs. The plant cover is more uniform on the shrub/scrub vegetation type generally varying less than 1% between transects within any subtype. The exception is in the alluvial flats and shallow wash complex where the shallow washes have up to 37% cover compared to no cover on some areas of the flats.

The highest number of perennial plant species per subtype was 16 in the shallow washes and the lowest was 0 in the desert pavement, then increases to 6 in the upland slopes. This is a medium to low diversity for desert vegetation and is typical for this lower desert region. This desert with extremely low rainfall requires highly adapted plant species, especially for perennial species. The wide spacing of plants allows for maximum water availability for individuals. The large size of our plots maximized the diversity index.

Vegetation Determination Within Four Expansion Areas

Vegetation subtypes were mapped within each of the four extension areas (see Figures 4-1 to 4-4). All of the sites have disturbance areas without vegetation. The disturbance is generally roads but aiso include dump areas and scraped sites. Table 4.4 gives the plant density by vegetation subtype for each of the four extension areas. Table 4.5 lists plant cover and diversity by vegetation subtype for the four areas.

Table 4-1. Identification and Locations for Baseline Vegetation Surveys for Mesquite Mine, 1999

Vegetation Subtype (Location)	Transect No.	Survey Date	Size (in meters)			No. of plots
			width	Length	total (m^2)	
Upland Slope (Big Chief OISA)	BC-1	4/24/99	6	100	600	10
	BC-2	4/24/99	6	100	600	10
	BC-3	9/1/99	6	100	600	10
	BC-4	9/1/99	6	100	600	10
Desert Pavement & Upland Complex (Big Chief North Extension)	NE-1	4/22/99	6	100	600	10
	NE-2	4/22/99	6	100	600	10
	NE-3	9/1/99	6	100	600	10
	NE-4	9/1/99	6	100	600	10
Alluvial Flats & Shallow Wash Complex (East Rainbow South OISA and Pit Extension)	ERS-1	4/24/99	6	100	600	10
	ERS-2	4/24/99	6	100	600	10
	ERS-3	9/2/99	6	100	600	10
	ERS-4	9/2/99	6	100	600	10
Large Wash (Big Chief North Extension)	NEW-1	9/1/99	6	50	300	9
	NEW-2	9/1/99	6	50	300	10
Medium Wash (East Rainbow North OISA)	ERN-2	9/2/99	10	25-45	340	10
Shallow Wash (East Rainbow North OISA)	ERN-1	4/24/99	10	30	300	10

Table 4-2. Perennial Plant Density by Vegetative Subtype, Mesquite Mine 1999

Plant Species	Shrub/scrub				Tree/shrub (washes)		
	desert pavement	upland slopes	pavement & upland	flats & washes	Large	medium	shallow
Trees							
Olneya tesota	0	0	0	4	0	0	29
Shrubs							
Acacia greggii	0	0	0	0	0	13	0
Ambrosia dumosa	0	83	13	145	84	218	566
Bebbia juncea	0	0	0	0	31	0	0
Calliandra eriophylla	0	0	0	2	0	269	116
Encelia farinosa	0	38	22	64	138	372	421
Fouquieria splendens	0	0	0	4	0	13	29
Hibiscus denudatus	0	0	0	5	0	26	29
Hymenoclea salsola	0	0	0	0	31	0	0
Hyptis emoryi	0	0	0	2	23	0	0
Krameria erecta	0	0	0	0	0	0	29
Larrea tridentate	0	83	31	49	53	64	44
Lycium andersonii	0	0	0	0	69	0	15
Psorothamnus schottii	0	0	0	0	0	0	15
Stephanomeria pauciflora	0	0	0	0	0	0	15
Grass							
Pleuraphis rigida	0	0	0	0	0	26	131
Herbaceous							
Fagonia laevis	0	0	0	0	8	0	116
Cactus							
Echinocactus polycephalus	0	7	2	0	0	0	0
Opuntia acanthocarpa	0	0	4	7	23	0	0
Opuntia basilaris	0	9	5	2	31	0	29
Opuntia bigelovii	0	0	9	20	0	0	58
Opuntia echinocarpa	0	0	0	4	8	13	0
Opuntia pencilatus	0	0	0	16	0	0	15
Total density	0	348	221	85	497	1012	1655

Table 4-3 Plant cover and diversity by vegetation subtype, Mesquite Mine 1999.

Vegetation subtype	Plant cover* (%)	Diversity
Shrub/Scrub Vegetation Type		
desert pavement	0	0
upland slopes	3	6
desert pavement & upland	1	10
flats & shallow wash	5	13
Tree/Shrub Vegetation Type		
wash – large	11	15
wash – medium	25	12
wash – shallow	23	16

Table 4-4 Density for each area by vegetation subtype with percent of each vegetation subtype, Mesquite Mine 1999.

Survey site	Vegetation subtype	Subtype as % of total site	Vegetation subtype size (acres)	Density (plants/acre)
Big Chief North Extension (51 acres)	desert pavement	16	9.2	0
	desert pavement & upland	33	14.7	85
	flats & shallow wash	5	2.8	348
	Wash – large	12	5.5	497
	Wash – medium	2	0.9	1012
	Disturbed	32	12.9	--
Big Chief OISA (0 acres)	Upland	93	18.5	221
	Disturbed	7	2.5	--
East Rainbow South OISA (103 acres) East Rainbow Pit Extension (25 acres)	desert pavement	60	78.1	0
	flats & shallow wash	19	19.9	348
	Wash – large	7	9.9	497
	Wash – medium	4	2.5	1012
	Wash – shallow	1	1.2	1655
	Disturbed	9	12.4	--
East Rainbow North OISA (6 acres)	desert pavement	50	13.2	0
	flats & shallow wash	9	2.2	348
	Wash – large	9	1.7	497
	Wash – medium	8	1.1	1012
	Wash – shallow	5	0.7	1655
	Disturbed	19	3.1	--

Table 4-5 Plant cover and diversity for each area by vegetation subtype, Mesquite Mine 1999.

Survey site	Vegetation subtype	Plant cover* (%)	Diversity
Big Chief North Extension	desert pavement	0	0
	desert pavement & upland	1	10
	flats & shallow wash	5	13
	wash – large	11	15
	wash – medium	25	12
Big Chief OISA	Upland	3	6
East Rainbow South OISA – Pit Extension	desert pavement	0	0
	flats & shallow wash	5	13
	wash – large	11	15
	wash – medium	25	12
	wash – shallow	23	16
East Rainbow North OISA	desert pavement	0	0
	flats & shallow wash	5	13
	wash – large	11	15
	wash – medium	25	12
	wash – shallow	23	16

* Plant cover does not include canopy overlap.

North Extension of the Big Chief Open Pit

This site has five vegetative subtypes. Most of the site is a desert pavement and desert pavement upland mixed type (photograph P-1 in Appendix B). Plant density for these vegetation subtypes is low so the weighted average plant density for the site is 128 plants/acre.

Big Chief Overburden/Interburden Storage Area (not disturbed)

This is the least complex site with only one disturbance area covering 2½ acres. The site is an upland slope (see photograph P-2) with plant density at 221 plants/acre, 3% plant cover, and 6 species of plants within our transects. This gives a weighted plant density average of 195 plants/acre.

East Rainbow North Overburden/Interburden Storage Area

Although this is a smaller site, it has a high complexity. The majority (60%) of the site is desert pavement with extremely low plant density. However, traverse this site with smaller washes grading into medium washes with different flow directions (see photograph P-3). The weighted average plant density for this site is 176 plants/acre.

East Rainbow South Overburden/Interburden Storage Area and Pit Extension

This is the largest area surveyed. Most of this site (63%) is desert pavement. One large swath through the middle of the site is a complex of alluvial flats and shallow washes (see photograph P-4). A large flat wash flows along the east side of the site. The weighted average plant density for this site is 132 plants/acre.

4.4 Salvage Soils

These extreme desert soils do not have any topsoil as is generally used during reclamation activities in more temperate climates. The very low, sporadic precipitation (about 4 inches per year long-term average) results in a very low plant cover and therefore very little organic input into the soil. In addition, the high temperatures and solar irradiance bake the soil, forming a generally water-impermeable surface. These soils do not form soil horizons or differentiated layers. Much of the organic matter is collected and utilized by ants, termites, and small mammals. Decomposition of the limited litter that exists is very slow and nutrients are quickly reutilized.

In the large and medium washes, the soil surface is disrupted by infrequent, but heavy, water flows. This water action breaks up the impenetrable soil surface but disrupts any soil formation. In the shallower washes, water flow is less vigorous and water collection is higher and therefore plant densities are higher. However, the gravelly, sandy texture of the soil does not allow for good water holding capacity. So the effective water input is still extremely low and sporadic.

Some soil can be salvaged from the shallow and medium washes, litter and fine soil deposition areas of the large washes, and underneath larger trees and shrubs. These areas have soils with finer textures and a higher amount of litter and organics. They also contain high numbers of seeds. These soils can be salvaged and used in reclamation activities.

Areas of potential soil salvage were mapped within three of the four extension areas (see Figures 4-5 to 4-7). The eliminated upland steep Big Chief OISA area had no salvageable soil. Table 4.6 lists percent of salvage areas and total probable salvage soil amounts for each extension area. Soil can be salvaged to a depth of 6 to 12 inches, so an average 9-

inch depth was used in calculations. The North Extension of Big Chief Pit would yield about 3.2 acres total of salvage soil. The East Rainbow OISA's would yield 0.4 and 11.5 acres of salvage soil for the North and South areas, respectively. Soil can also be salvaged from the two extension areas not surveyed, the Big Chief Diversion Structure and East Rainbow Pit Extension, at approximately the rate of 7% of the area.

Table 4-6. Soil Salvage for Extension Areas, Mesquite Mine, 1999

Location	Total site acreage	Salvage area as % of total site	Salvage soil extent[1] (acres)	Total volume of salvage soil[2] (cubic yards)
Big Chief North Extension	51	21%	3.2	3,870
Big Chief OISA	21	0%	0	0
East Rainbow South OISA and Pit extension	128	30%	11.5	13,915
East Rainbow North OISA	6	22%	0.4	485

1. site acreage X salvage area % X 30% (typical) salvageable material
   e.g. 30% X 21% = 6.3% X 51 acres = 3.2 salvageable
2. salvage soil to an average depth of 9 inches

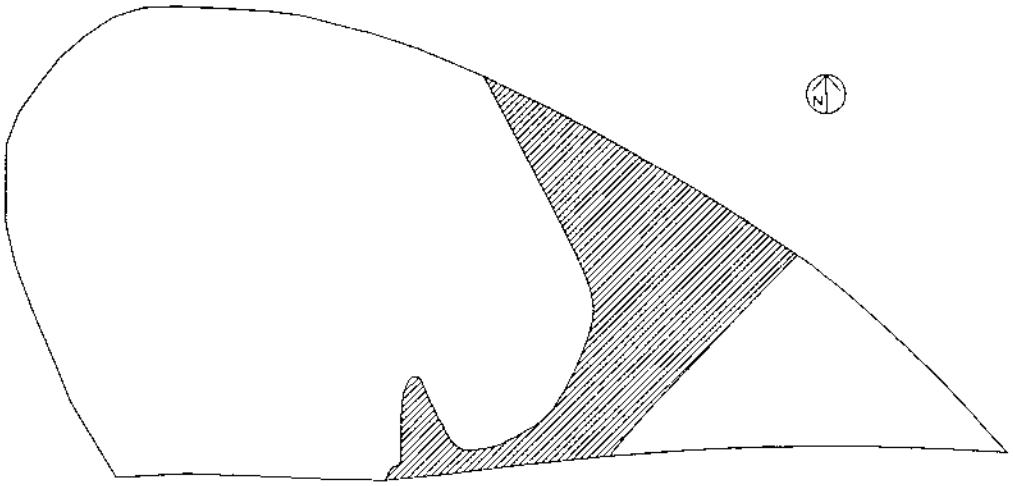


Figure 4–5 Soil salvage potential for the North Pit Extension area. Mesquite Mine, October 1999

▨ Area with potential soil salvage.

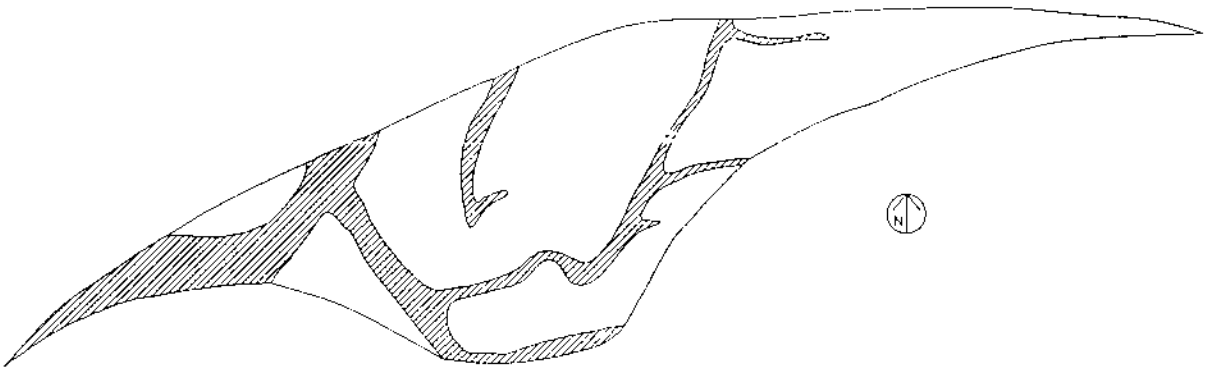


Figure 4–6 Soil salvage potential for the East Rainbow North OISA. Mesquite Mine, October 1999

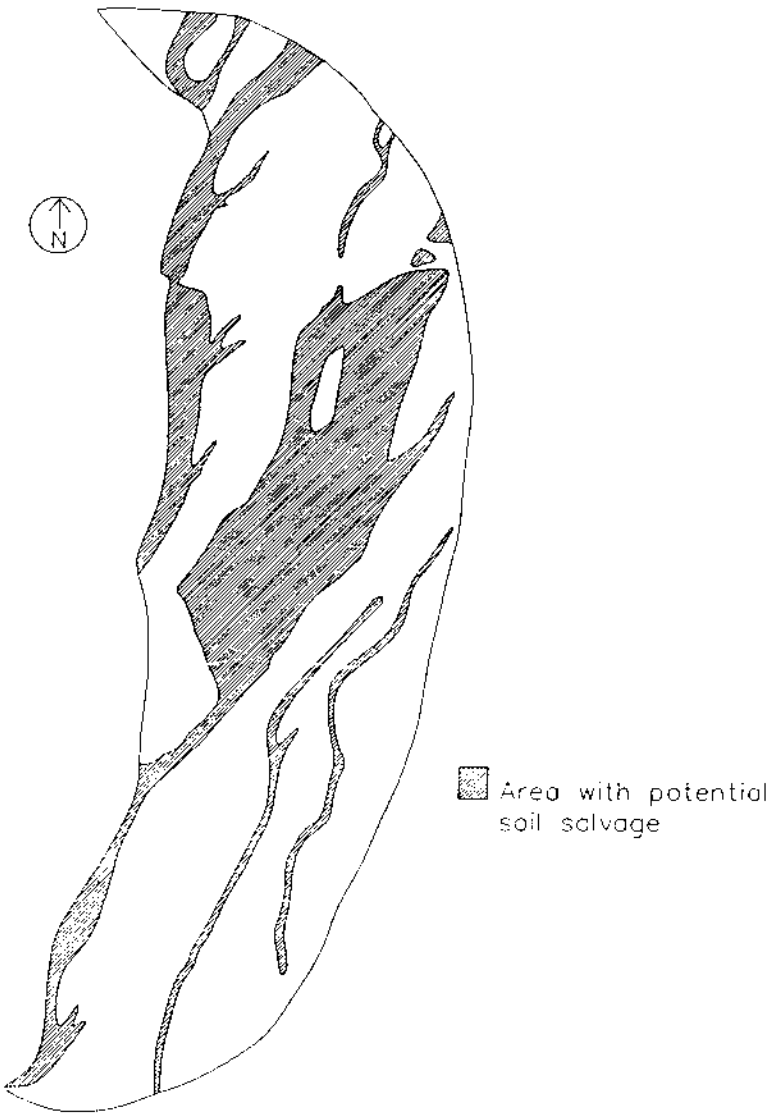


Figure 4–7 Soil salvage potential for the East Rainbow South OISA, Mesquite Mine, October 1999

5.0 SUMMARY AND DISCUSSION

The biological resources within the Mesquite Mine Project are typical for the lower, hot climate of this Sonora Desert region in southeastern California. The vegetation of the proposed Extension Areas is a typical desert creosote bush shrub/scrub. We identified two general vegetation types: a shrub/scrub vegetation dominated by widely spaced shrub plants on alluvial flats and slopes; and tree/shrub vegetation with small trees and a greater diversity of shrubs associated with the washes and drainages. The shrub/scrub vegetation type covered over nine-tenths of the study areas within the project boundaries and we further divided this type into four subtypes. We divided the tree/shrub vegetation into three subtypes based on wash size. Topographic and soil differences occur over the study area and this was reflected in the varied heterogeneous vegetation types and patterns on the project site.

The dominant shrubs in order of abundance are *Encelia farinosa* (inciensio), *Ambrosia dumosa* (burrobush), *Larrea tridentata* (creosote bush), and the cactus *Opuntia bigelovii* (teddy-bear cholla). The two common tree species, *Olneya tesota* (desert ironwood) and *Cercidium floridum* (palo verde), are mostly confined to wash areas at relatively low densities. Perennial shrubs are the dominant vegetation, with trees and a few herbaceous perennials present on the sides and islands of the washes.

Perennial plant densities in the vegetation subtypes ranged from 0 plants/acre on the desert pavement to 1655 plants/acre in the shallow washes. Tree/shrub vegetation type had an average density of 1055 plants/acre and covered about 10% of the extension sites. Shrub/scrub vegetation type had an average density of 164 plants/acre and covered about 75% of the extension sites. The remaining 15% was disturbed due to roads and other soil surface disruption with no or very little plant cover. Plant diversity averaged 12 species in areas with plant cover. This is a medium to low diversity indicating the low number of perennial species and wide spacing of individual plants. Cover followed a similar pattern to density with shrub/scrub vegetation type having an average of 5% cover or less, and tree/shrub with between 11 and 25% average cover in the transects measured.

Reclamation of the area can be accomplished using methods we are presently using and testing on the Mesquite Mine site. We have also tested these methods for the last 10

years at the nearby gold mining projects near Picacho Peak and in the Cargo Muchacho Mountains. These methods include recontouring for moisture enhancement, no irrigation, and revegetation using native plant species from seed. Most of the larger washes in the central portion of the project site will not be disturbed during mine development. Soil can be salvaged, where practical, from about 7% of the extension areas. Plant specimens can be salvaged, where practical, during mine construction, and include species of cactus and *Fouquieria splendens* (ocotilla). These plants can be marked prior to start of construction, and relocated to appropriate sites.

List of Common Plant Species at Mesquite Mine

Scientific Name	Common Name	Scientific Name	Common Name
Trees			
Cercidium floridum	palo verde	*Prosopis velutina*	mesquite
Olneya tesota	Desert ironwood		
Shrubs			
Acacia greggii	Catsclaw	*Krameria erecta*	Purple heather
Ambrosia dumosa	Burrobush	*K. grayi*	Desert ratany
Asclepias subulata	Milkweed	*Krascheninnikovia lanata*	winterfat
Bebbia juncea	Sweetbush	*Larrea tridentata*	creosote bush
Calliandra eriophylla	fairy duster	*Lycium andersonii*	box thorn
Ditaxis lanceolata	lance-leaved ditaxis	*L. cooperi*	box thorn
D. neomexicana	Ditaxis	*Nicotiana obtusifolia*	tobacco
Encelia farinosa	Inciensio	*Porophyllum gracile*	Odora
Fouquieria splendens	Ocotillo	*Psorothamnus schottii*	indigo bush
Hibiscus denudatus	rose mallow	*Simmondsia chinensis*	Jojoba
Hymenoclea salsola	Cheesebush	*Stephanomeria pauciflora*	wire lettuce
Hyptis emoryi	desert lavender		
Cactus			
Echinocactus polycephalus	cotton-top cactus	*Opuntia basilaris*	beavertail cactus
Mammilaria tetrancistra	nipple or fishhook cactus	*O. bigelovii*	teddy-bear cholla
Opuntia acanthocarpa	Buckhorn cholla	*O. ramosissima*	pencil cactus
O. echinocarpa	golden cholla		
Grasses			
Achnatherum speciosum	desert needlegrass	*Erioneuron pulchellum*	fluff grass
Aristida purpurea	triple-awned grass	*Pleuraphis rigida*	big galleta grass
Bromus madritensis	red brome	*Schismus barbatus*	mediterranean grass
B. tectorum	downy chess		
Herbs			
Amsinckia tessellata	Fiddleneck	*Gilia spp.*	Gilia
Atrichoseris platyphylla	gravel-ghost	*Gilia latifolia*	Gilia
Brassica tournefortii	Mustard	*Hesperocallis undulata*	Desert lily
Calycoseris wrightii	yellow tack-stem	*Horsfordia newberryi*	Yellow felt-plant
Camissonia boothii	booth's evening primrose	*Langloisia setosissima*	langloisia
C. brevipes	Evening primrose	*Lepidium lasiocarpum*	peppergrass
C. claviformis	club evening primrose	*Loeseliastrum schottii*	Calico
C. refracta	narrow-leaved primrose	*Lotus sirigosus*	Lotus
Chaenactis carphoclinia	pebble pincushion	*Mentzelia albicaulis*	small-flowered blazing star

C. stevioides	Chaenactis	*M. involucrata*	sand blazing star
Chamaesyce albomarginata	white-fringed sandmat	*Mohavea confertifolia*	ghost flower
C. polycarpa	prostrate spurge	*Mirabilis bigelovii*	four o'clock
Chorizanthe brevicornu	brittle spine-flower	*Monoptilon bellioides*	Desert star
C. corrugata	Corrugata	*Nama demissum*	Purple mat
C. rigida	spiny chorizanthe	*Nemacladus glanduliferus*	Thread plant
Cryptantha angustifolia	narrow-leaved forget-me-not	*N. rubescens*	rigid-stemmed thread plant
C. barbigera	Bearded forget-me-not	*Oligomeris linifolia*	linear-leaved cambess
C. circumscissa	Western forget-me-not	*Pectocarya platycarpa*	broad-nutted comb-bur
C. dumetorum	Flexuous forget-me-not	*Perityle emoryi*	rock daisy
C. maritima	white-haired forget-me-not	*Phacelia crenulata*	notch-leaved phacelia
C. micrantha	Nevada forget-me-not	*P. distans*	fern phacelia
Dalea mollissima	Indigobush	*P. fremontii*	fremont phacelia
Descuriana pinnata	yellow tansy mustard	*Plantago ovata*	Plantain
Eremalche rotundifolia	desert five-spot	*Psathyrotes ramosissima*	Turtleback
Eriastrum diffusum	Eriastrum	*Salsola tragus*	russian thistle
Eriogonum inflatum	desert trumpet	*Salvia columbariae*	Chia
E. pusillum	yellow turbin	*Sarcostemma cyanchoides*	climbling milkweed
E. thomasii	thomas buckwheat	*Streptanthella longirostris*	small jewelflower
Erodium texanum	desert heron's bill	*Tiquilia canescens*	Tiquilia
Eschscholtzia minutiflora	little gold poppy	*Trichoptilium incisum*	Yellow-head
Euphorbia eriantha	beetle spurge	*Trixis californica*	Trixis
Fagonia laevis	smooth-stemmed fagonia	*Uropappus lindleyi*	silver puffs
Geraea canescens	desert sunflower		

(Nomenclature according to The Jepson Manual, 1993)

Adapted from a list of plant species for this area by Ted Rado, Consulting Biologist, Riverside.

Photograph P-1 View south across the north extension of the Big Chief Pit.

Photograph P-2 View north across upland slopes of the Big Chief OISA.

Photograph P-3 View to the north of shallow washes in the East Rainbow South OISA.

Photograph P-4 View to the west of the East Rainbow North OISA.